



Isogeometric Analysis and Shape Optimisation

Gravesen, Jens; Evgrafov, Anton; Gersborg, Allan Roulund; Nguyen, Dang Manh; Nielsen, Peter Nørtoft

Publication date:
2011

[Link back to DTU Orbit](#)

Citation (APA):

Gravesen, J., Evgrafov, A., Gersborg, A. R., Nguyen, D. M., & Nielsen, P. N. (2011). *Isogeometric Analysis and Shape Optimisation*. Abstract from 11th US National Congress on Computational Mechanics, Minneapolis and St. Paul, Minnesota, United States. <http://www.usnccm.org/>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Isogeometric Analysis and Shape Optimisation

Jens Gravesen¹, Anton Evgrafov², Allan Roulund Gersborg³,
Nguyen Dang Manh⁴, and Peter Nørtoft Nielsen⁵

¹Associate Professor and presenting author, Technical University of Denmark, Department of Mathematics, email: J.Gravesen@mat.dtu.dk

²Associate Professor, Technical University of Denmark, Department of Mathematics

³Assistant Professor, Technical University of Denmark, Department of Mechanical Engineering

⁴Ph.D. Student, Technical University of Denmark, Department of Mathematics

⁵Ph.D. Student, Technical University of Denmark, Department of Mathematics and Department of Mechanical Engineering

One of the attractive features of isogeometric analysis is the exact representation of the geometry. The geometry is furthermore given by a relative low number of control points and this makes isogeometric analysis an ideal basis for shape optimisation. I will describe some of the results we have obtained and also some of the problems we have encountered.

One of these problems is that the geometry of the shape is given by the boundary alone. And, it is the parametrisation of the boundary which is changed by the optimisation procedure. But isogeometric analysis requires a parametrisation of the whole domain. So in every optimisation cycle we need to extend a parametrisation of the boundary of a domain to the whole domain. It has to be fast in order not to slow the optimisation down but it also has to be robust and give a parametrisation of high quality. These are conflicting requirements so we propose the following approach. During the optimisation a fast linear method is used, but if the parametrisation becomes singular or close to singular then the optimisation is stopped and the parametrisation is improved using a nonlinear method. The optimisation then continues using a linear method.

We will explain how the validity of a parametrisation can be checked and we will describe various ways to parametrise a domain. We will in particular study the Winslow functional which turns out to have some desirable properties.

Other problems we touch upon is clustering of boundary control points (design variables) and self intersection of the design. The first problem can be solved by a suitable regularisation and the latter by a method that resembles how the validity of the parametrisation is secured.

References

- [1] Nguyen D.M., A. Evgrafov, A.R. Gersborg, and J. Gravesen, Isogeometric shape optimization of vibrating membranes, *Computer Methods in Applied Mechanics and Engineering*, 200, pp. 1343–1353, 2011.